

OCE 101

Spring 2010

Introduction to
Underwater Acoustics

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Overview

Overview of acoustics

Some fundamentals of acoustics

Applications of acoustics in the ocean

Acoustical transducers

Sound propagation in the ocean

Sounds in the ocean -- cd

OE acoustic test tank

Some demos in acoustics

Visit the websites:

<http://asa.aip.org>

<http://dosit.org>

**Acoustical Society
of
America**

Visit the
website:
<http://asa.aip.org>

Education

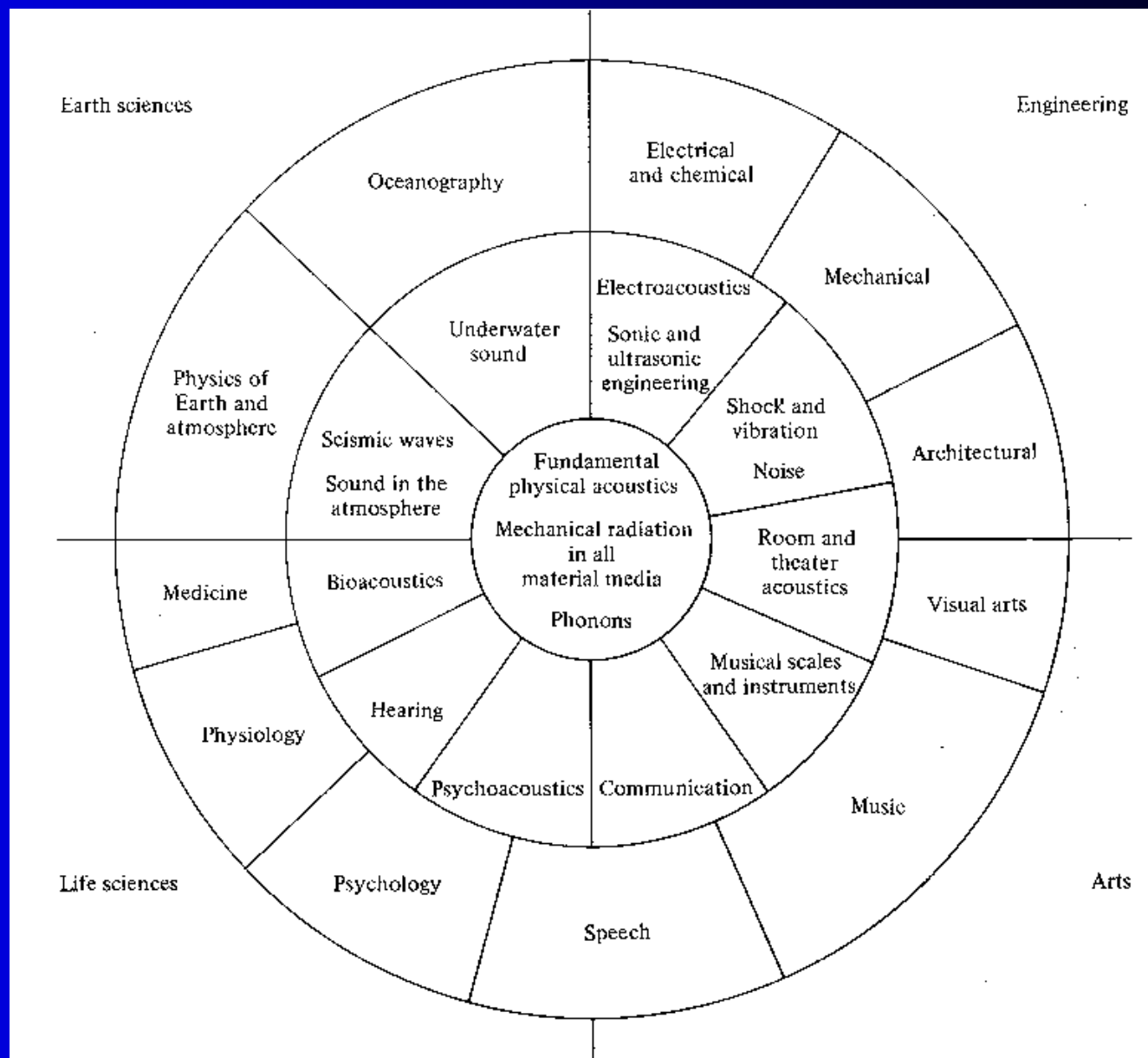
Listen to Sounds

Links

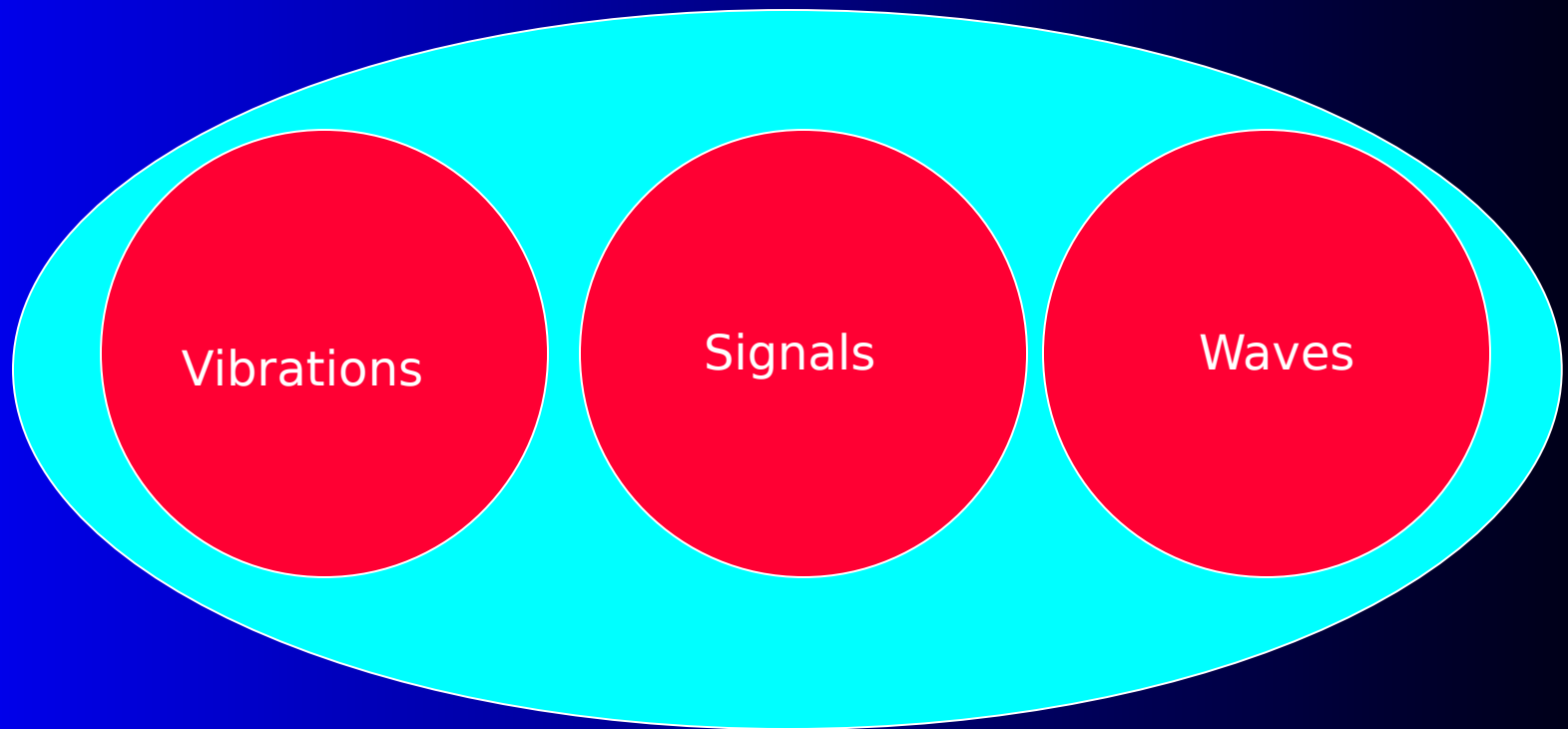
Jobs

Press Room

Standards Store



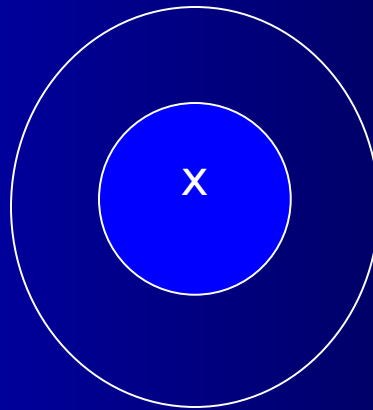
Fundamentals of Acoustics



Acoustics

Simple definition of a wave ---- disturbance which moves away from a source with no transport of matter

A simple example ----- drop a pebble in water



Some aspects of waves

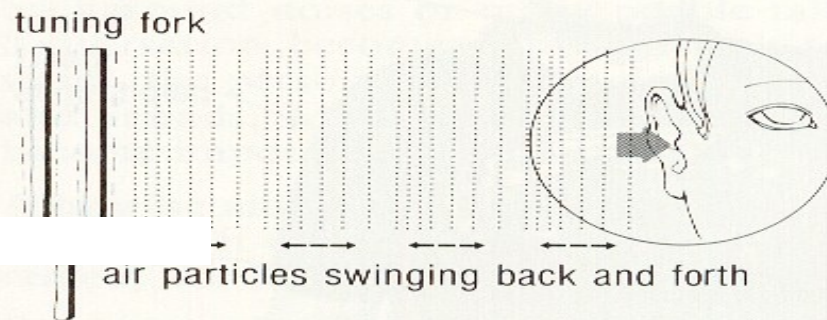
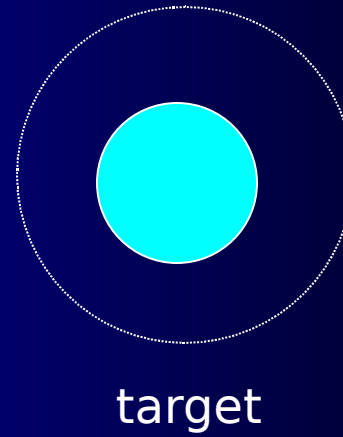
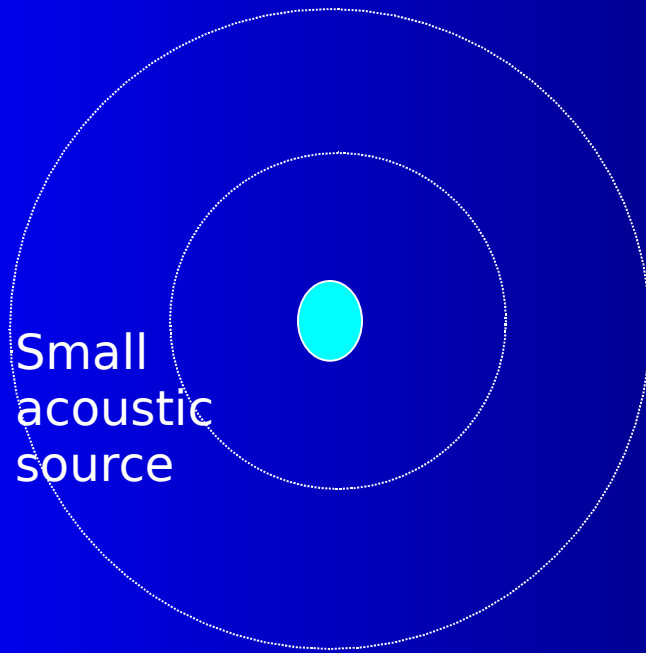


Figure 3. The sound source vibrates and affects air particles, which strike the ear drum.

Some fundamentals of acoustics



Acoustic wavespeeds

340 m/s ----- air

1500 m/s -----water

5000 m/s ----- solids

Note: Speed of light is 3×10^8 m/s

Some wavespeeds of interest

Sound
generation

Sound
transmission

Sound
reception

Common examples:

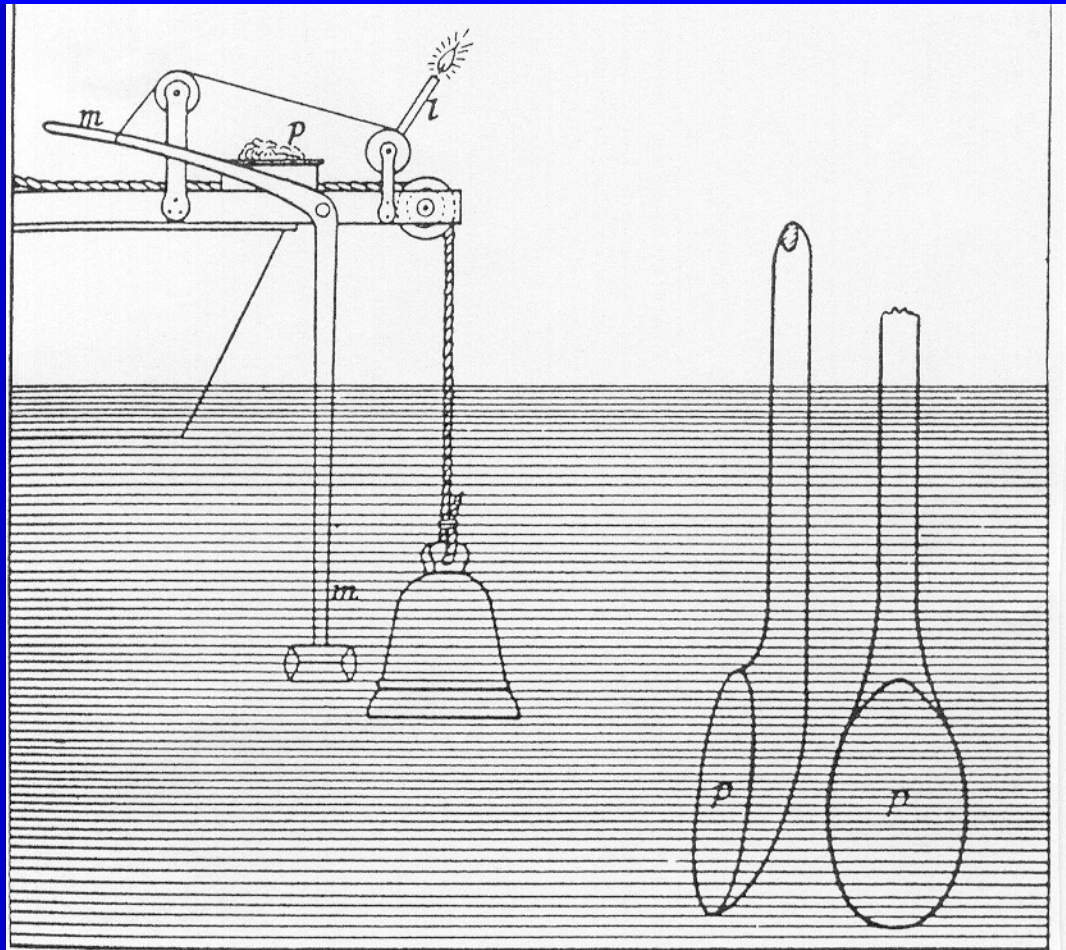
Acoustic communication

Environmental noise

Underwater applications

A typical acoustical system

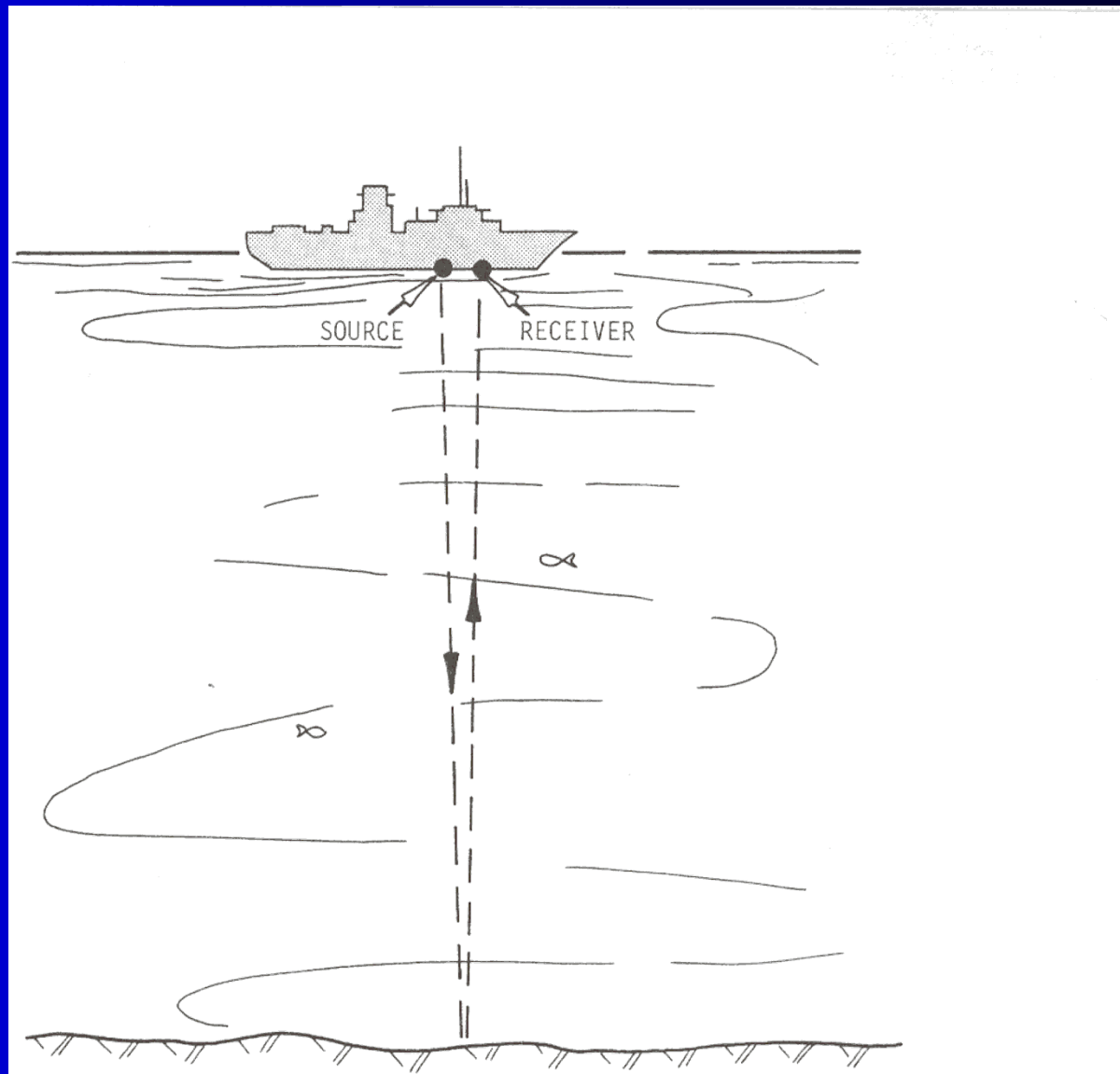
Some Applications of Acoustics in the Ocean



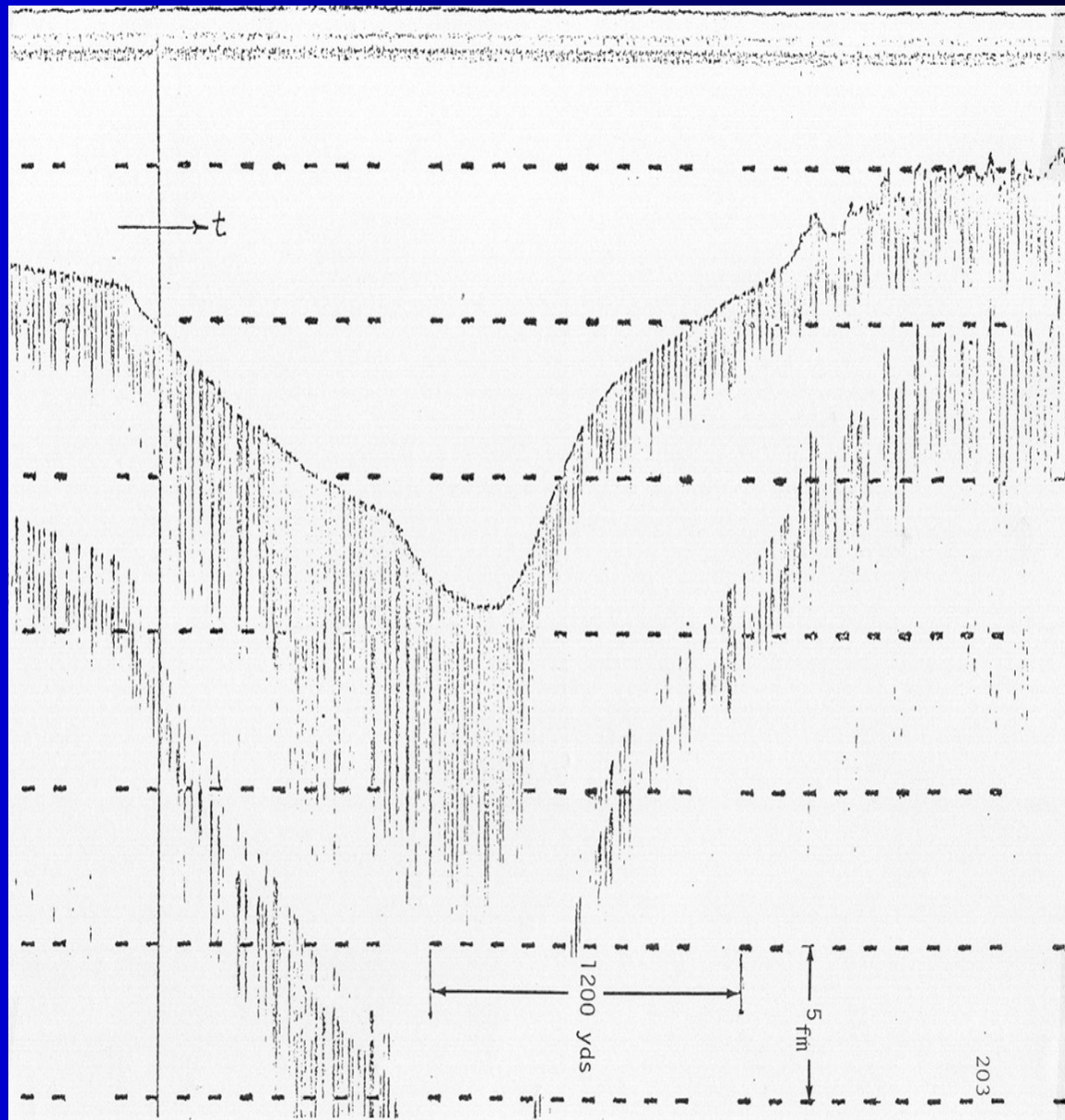
An early experiment to measure the speed of sound
----- performed in 1827

- Depth sounding
- Bottom mapping
- Sub-bottom mapping
- Object locating
- Telemetry
- Homing
- Station keeping

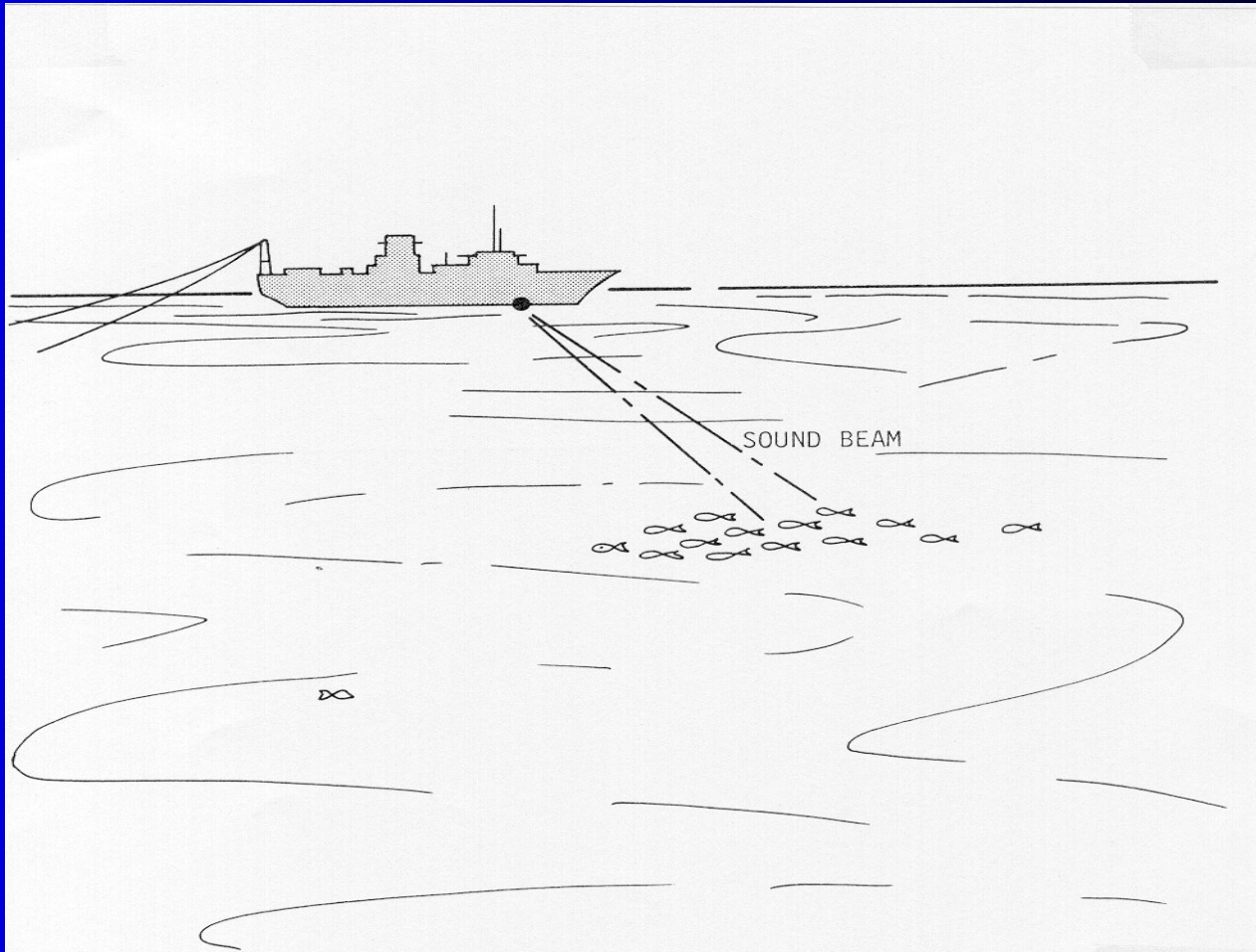
Civilian applications of acoustics in the ocean



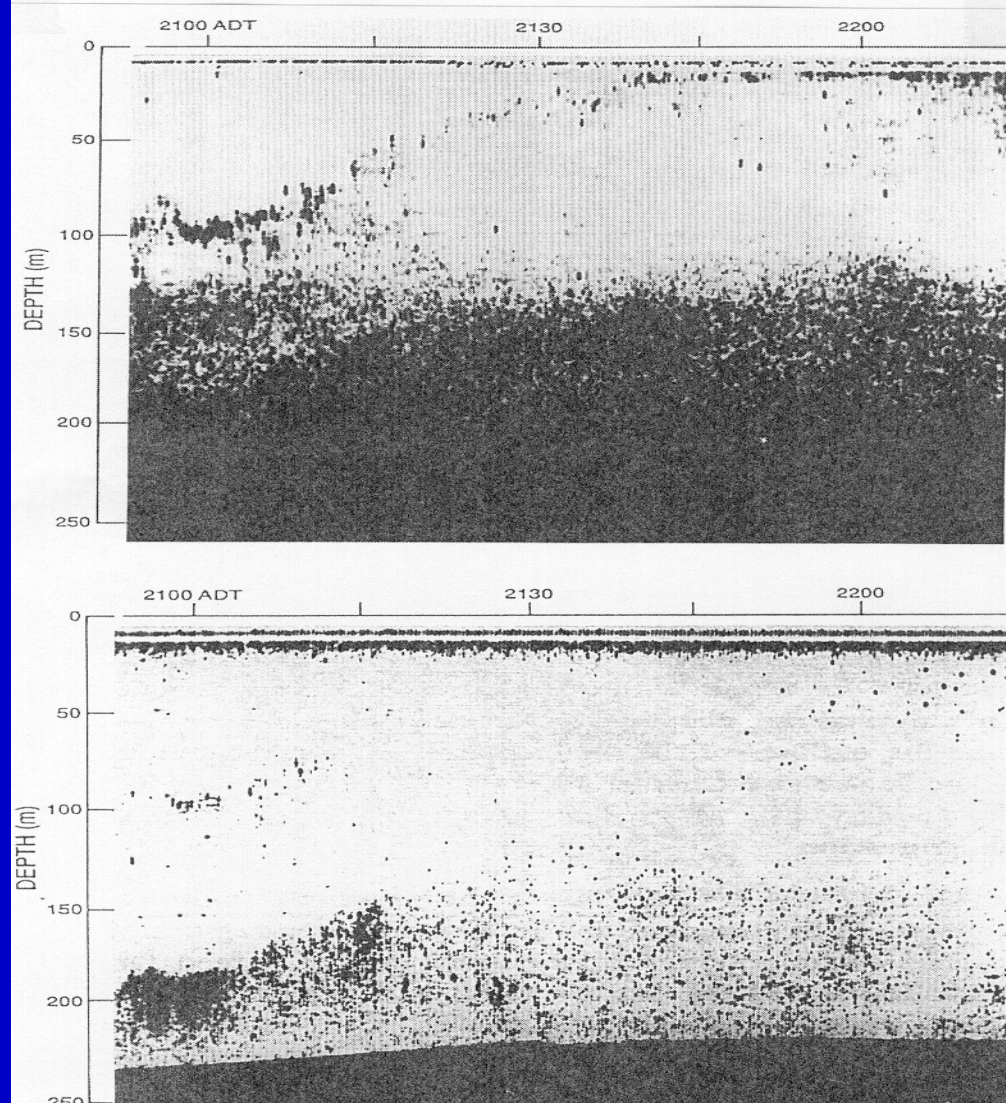
A depth sounder



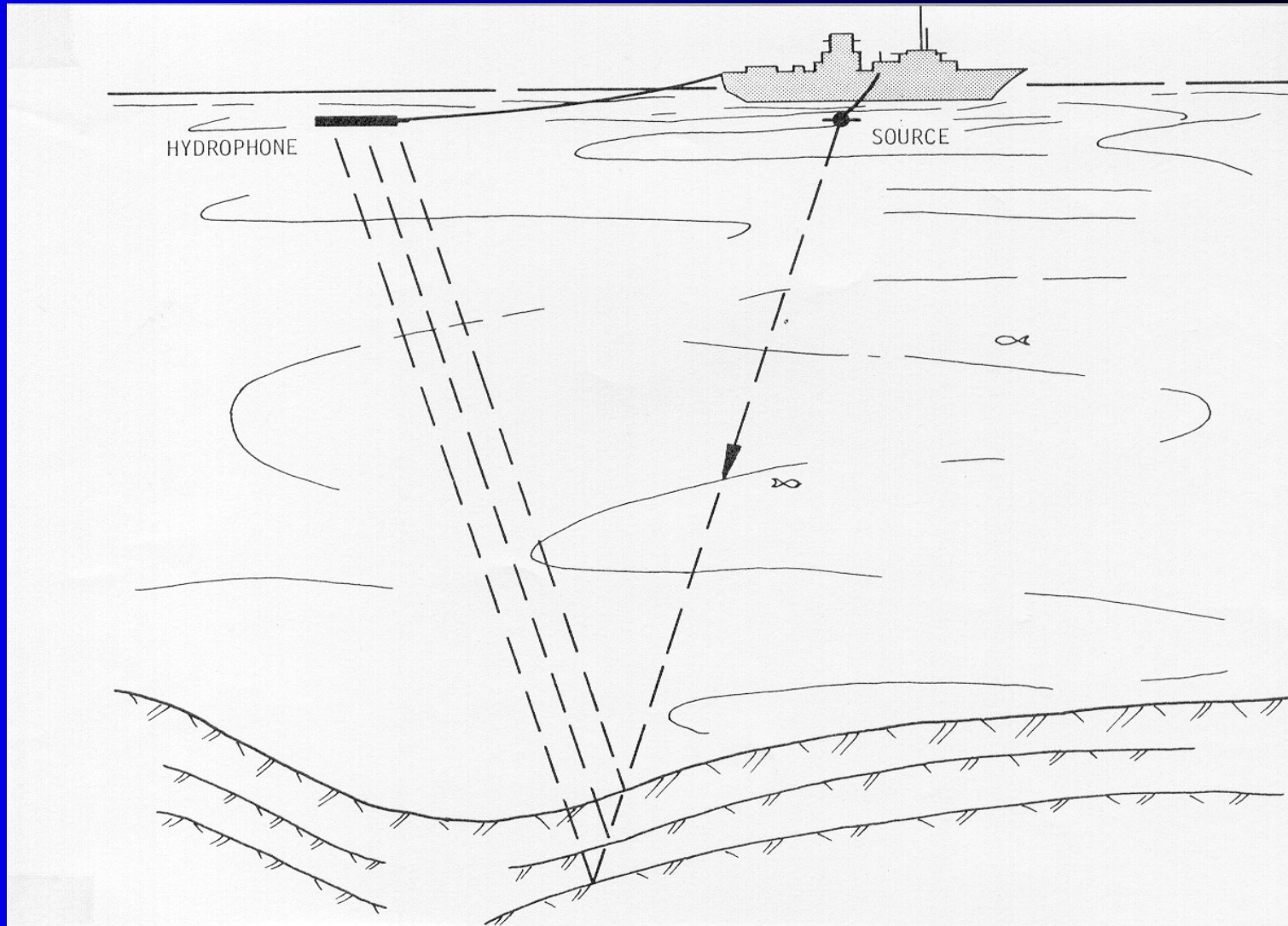
A typical depth sounder scan ----- Buzzards Bay



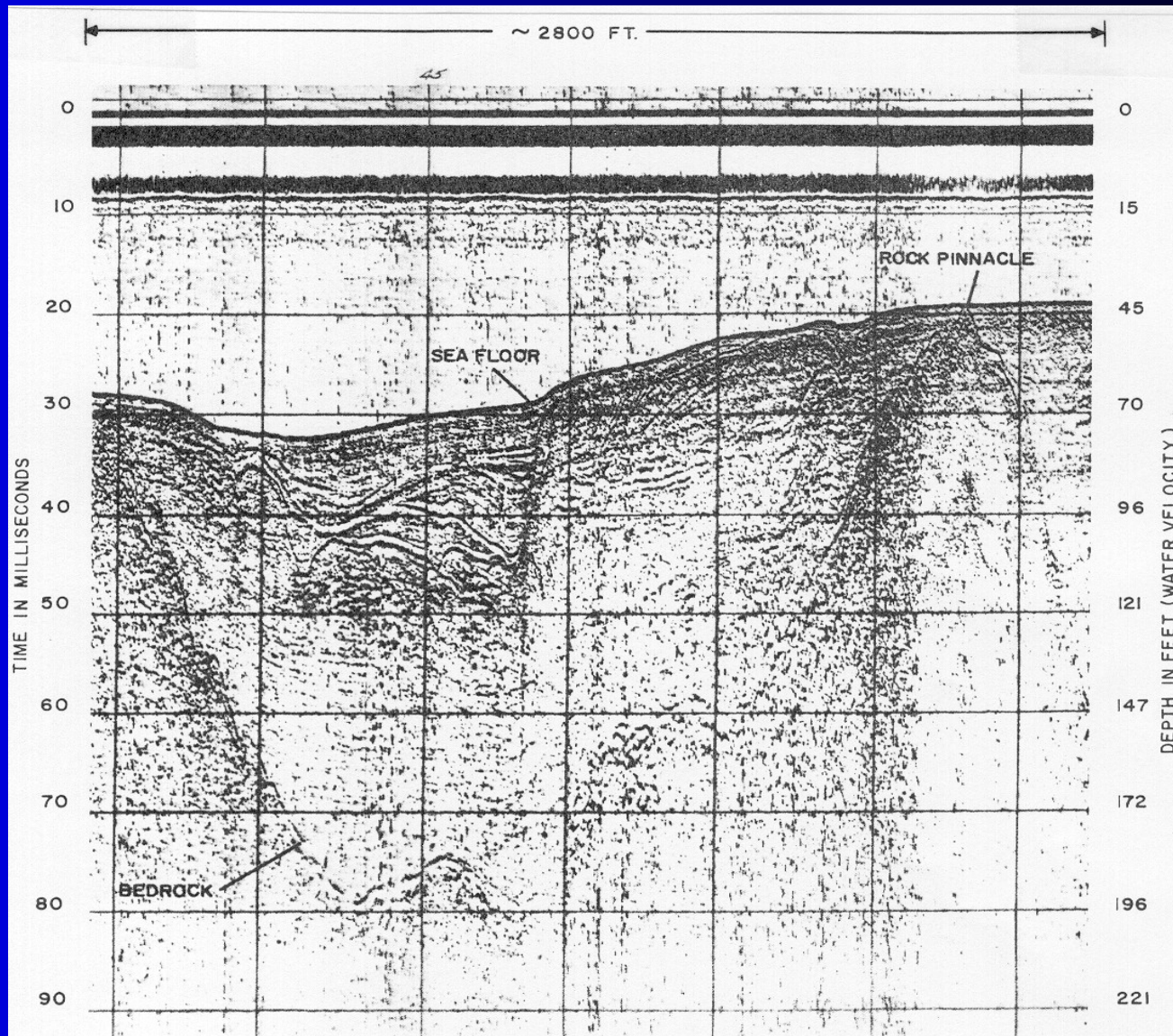
Echo locating sonar



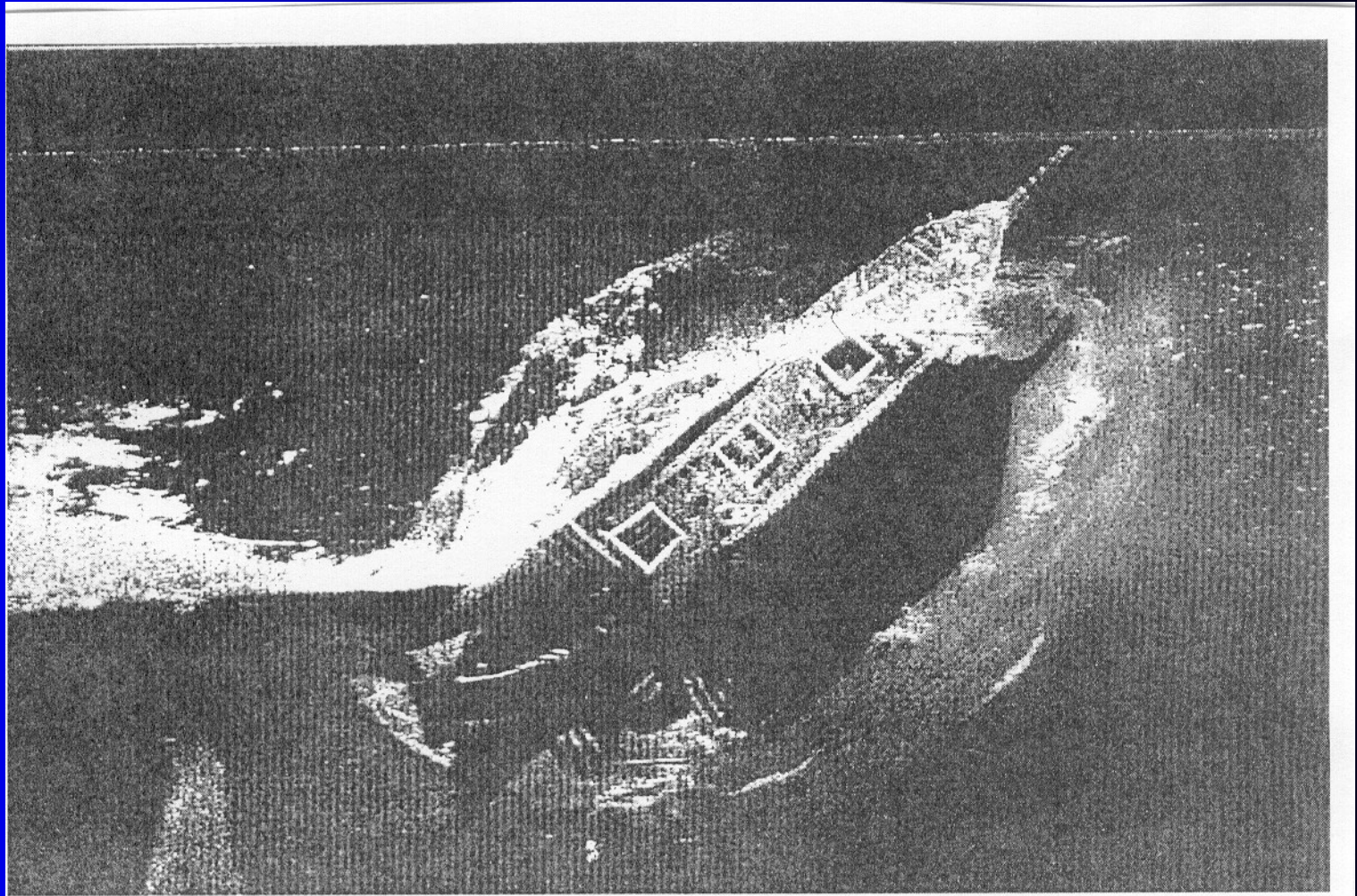
Echo locating sonar scan



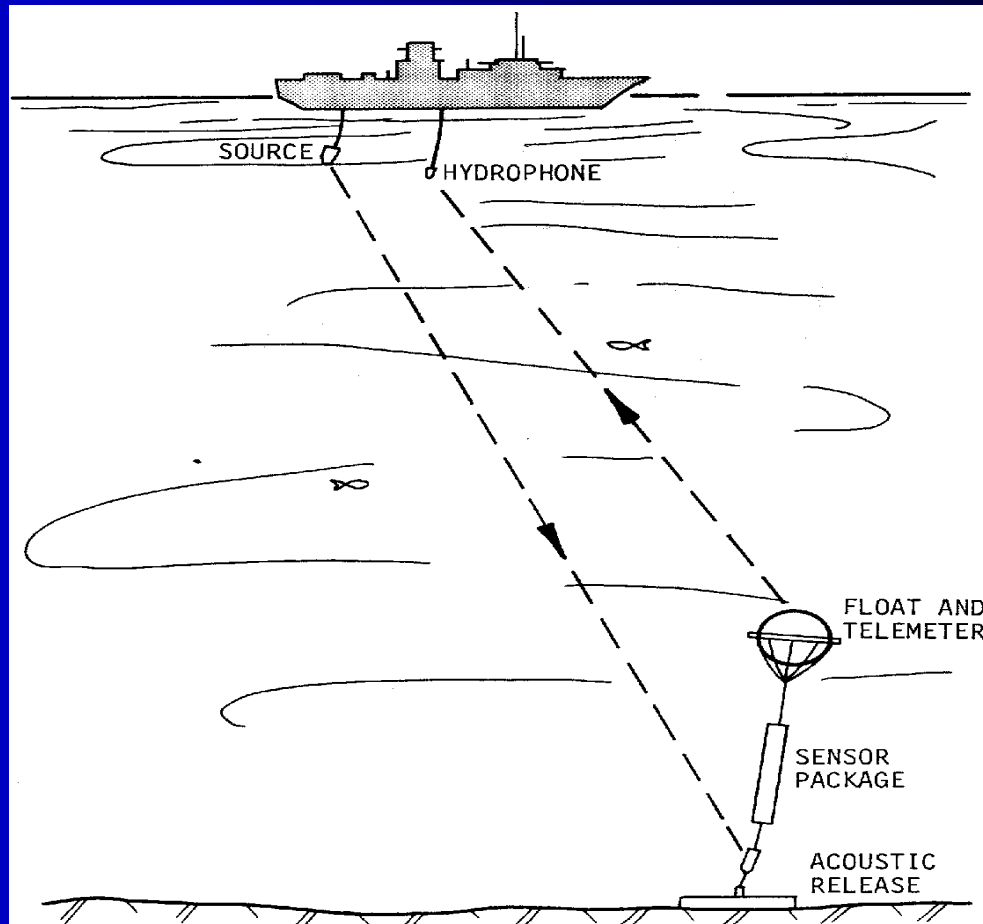
Sub-bottom profiling



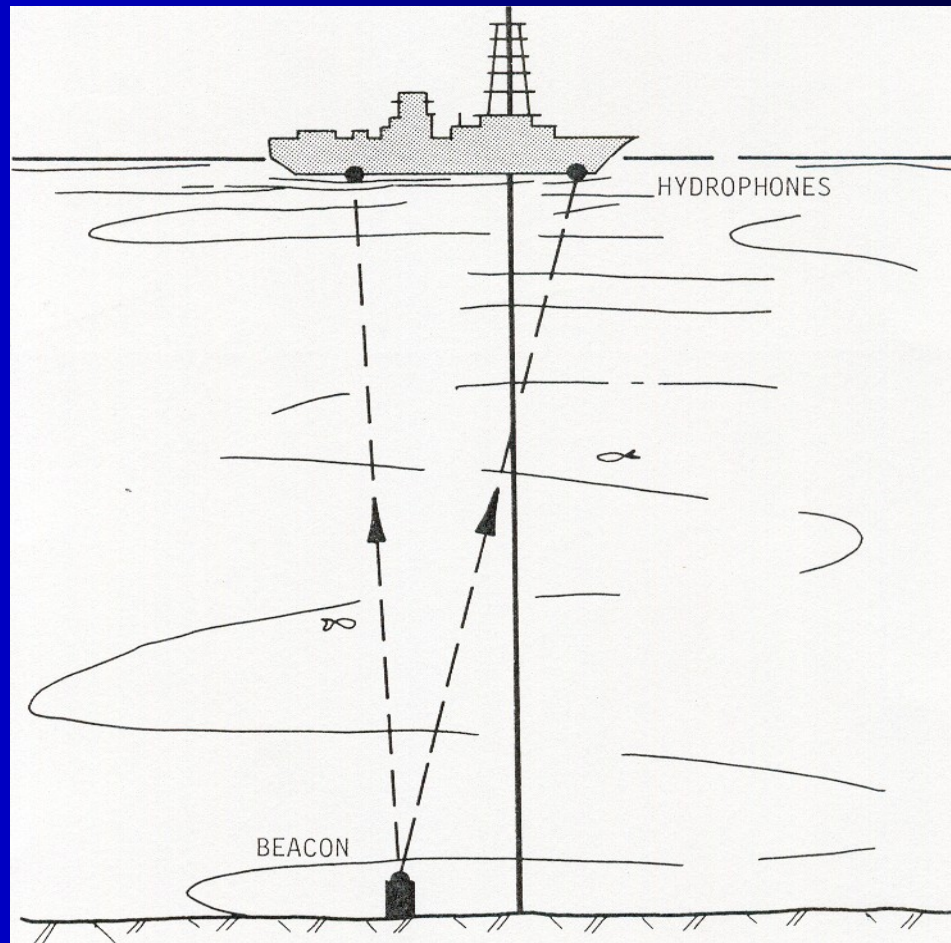
Sub-bottom scan record



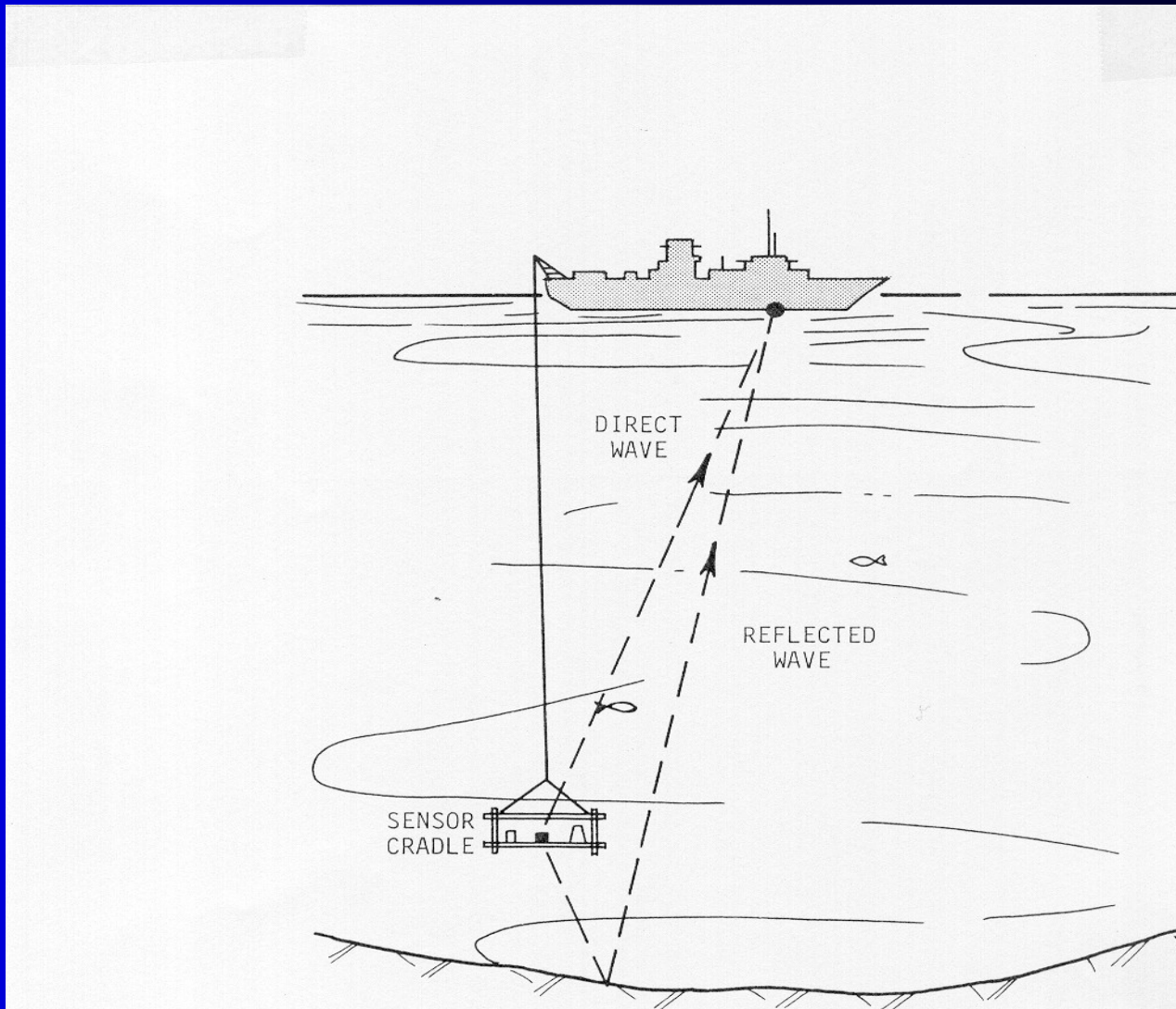
Side scan sonar image of ship on ocean bottom



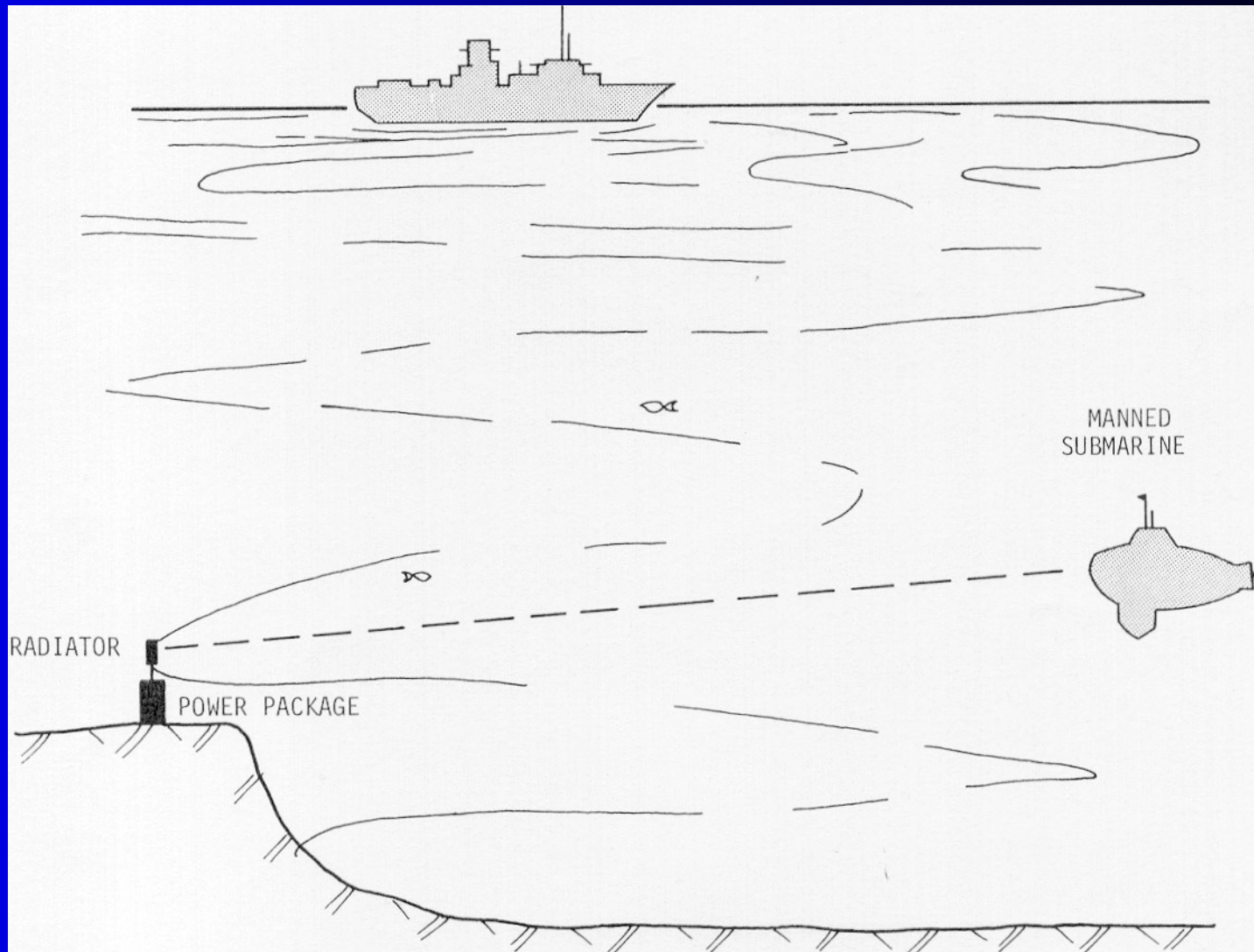
Acoustic telemetry and release system



Acoustic station-keeping system



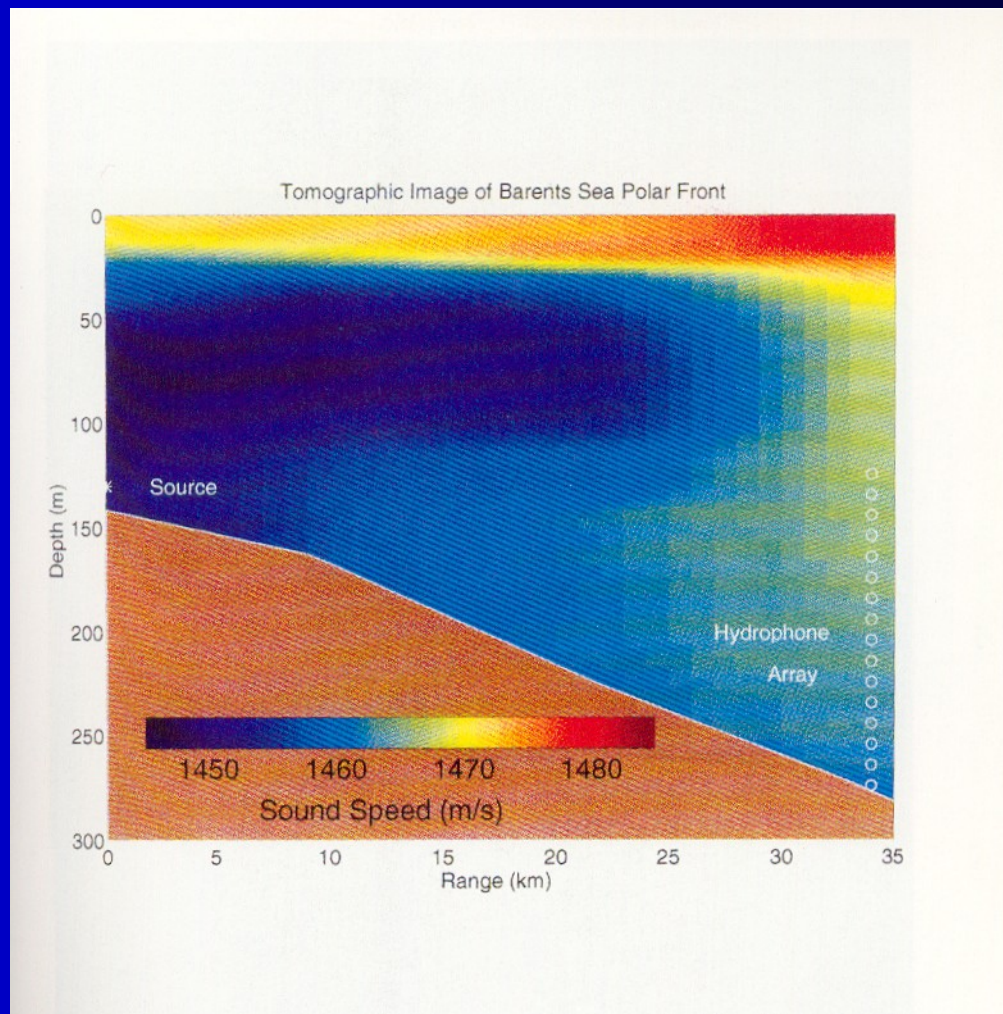
Acoustic positioning control

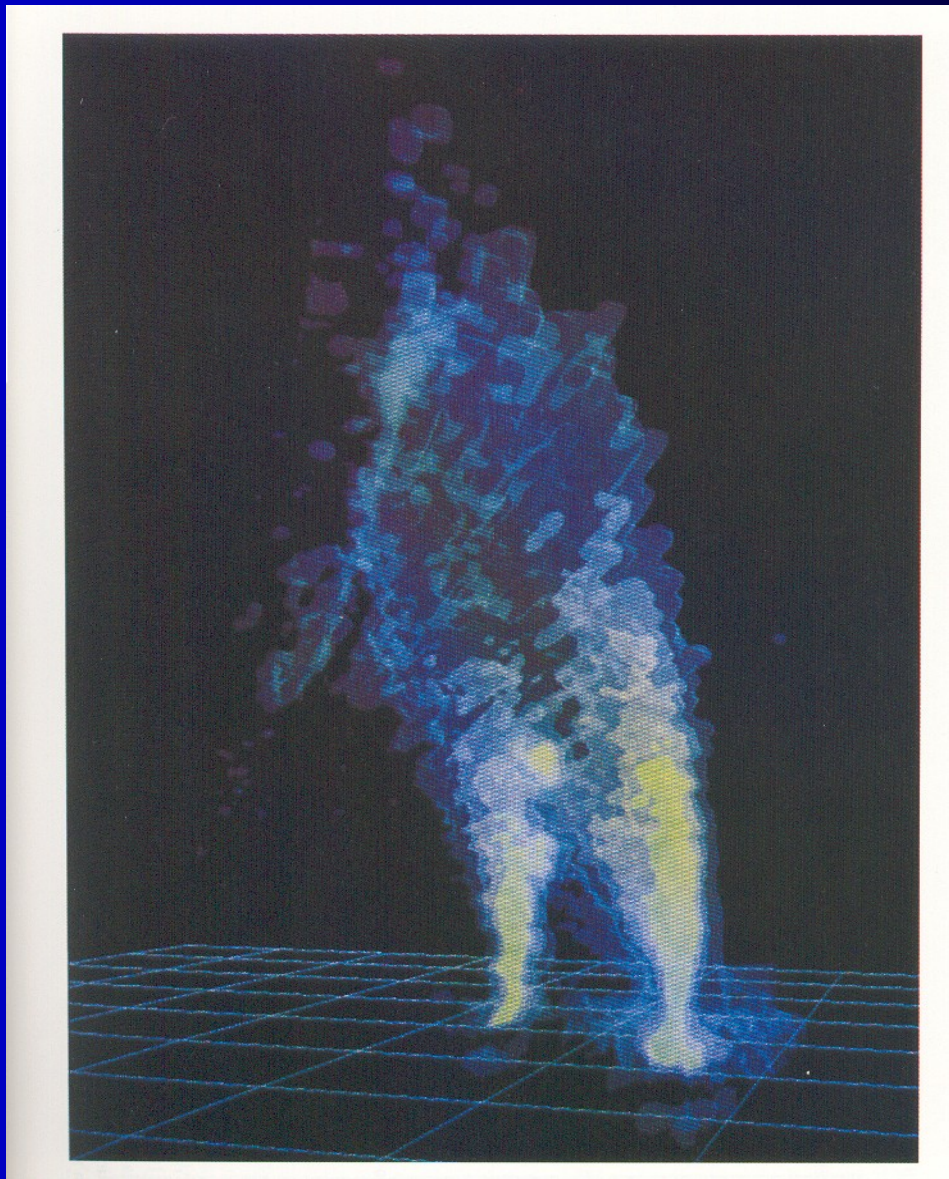


Acoustic homing system

- Detection of targets
- Tracking
- Location
- Classification
- Surveillance of oceans

Military applications of acoustics in the ocean





Hydro-thermal plumes from hot springs on the ocean floor

- § Whales and porpoises
- § Rain storms
- § Shrimp
- § Various fish
- § Underwater landslides
- § Ice cracking

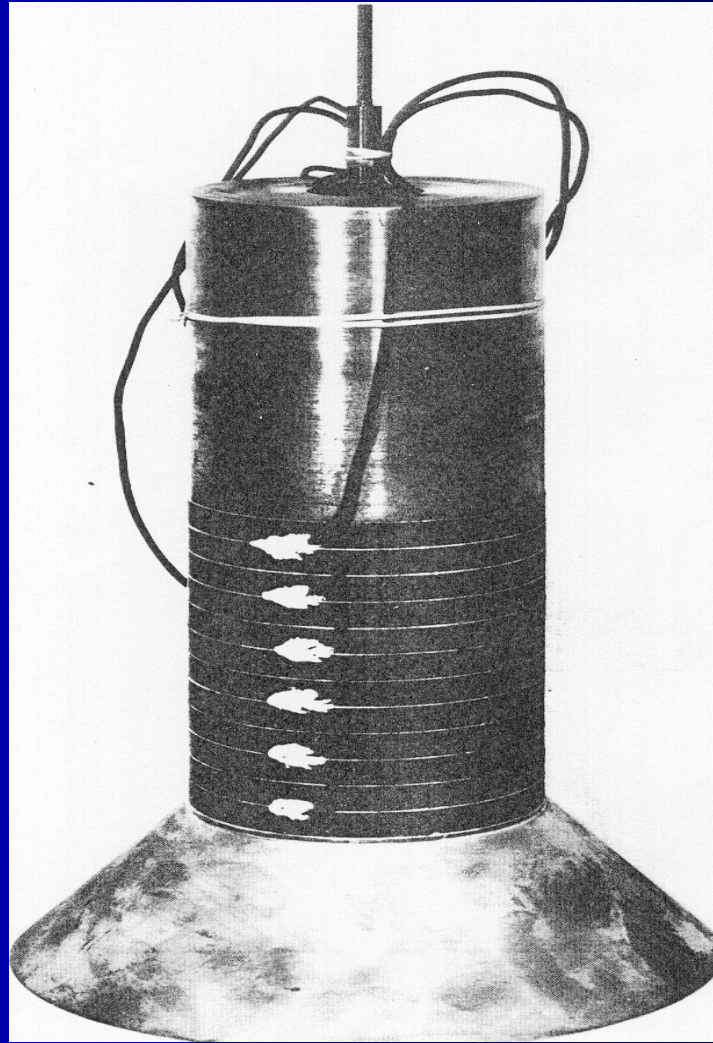
CD with some common underwater sounds

Acoustic transducers

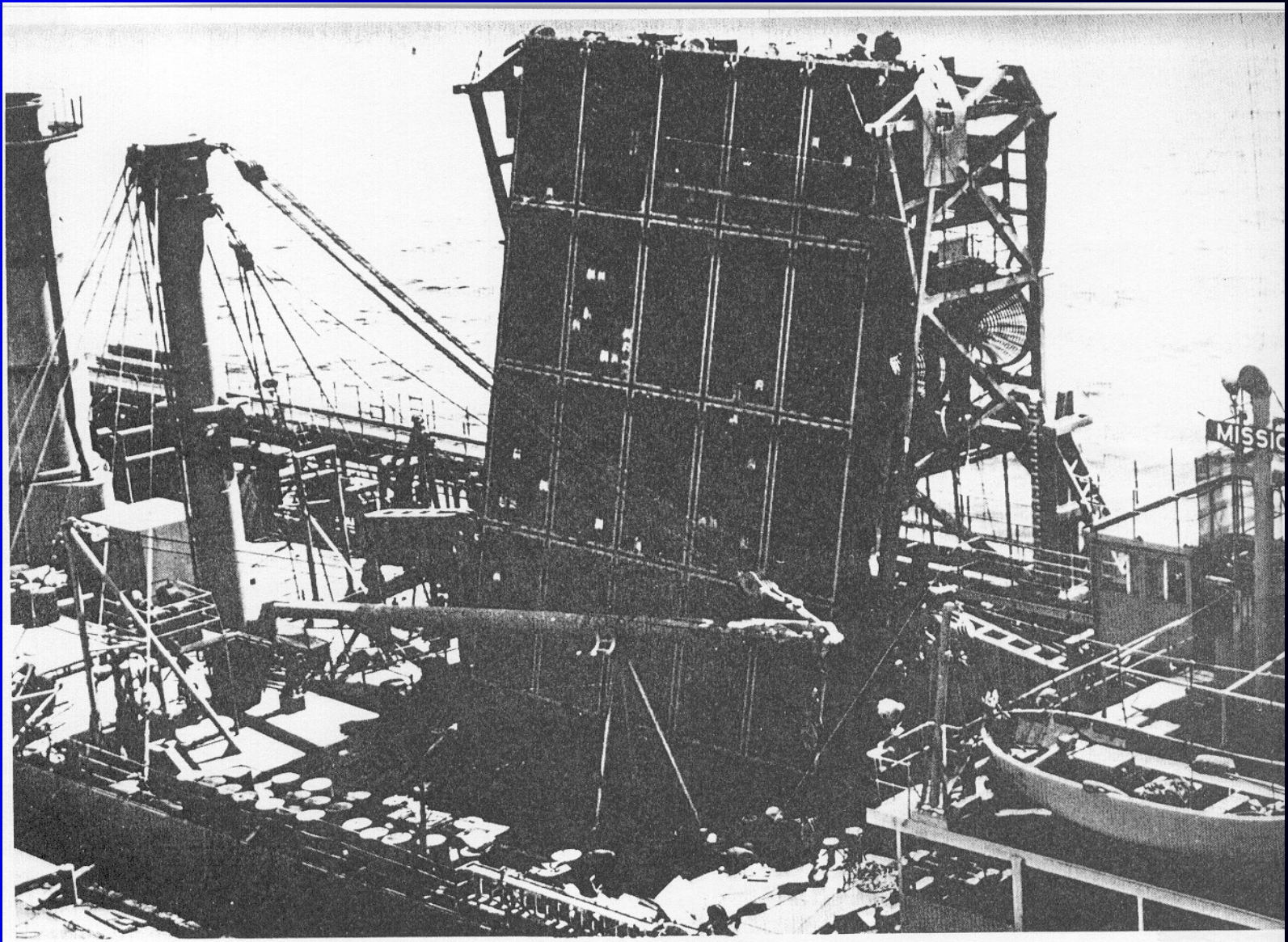
Acoustical transducers

Low frequency ----- large
High frequency ----- small

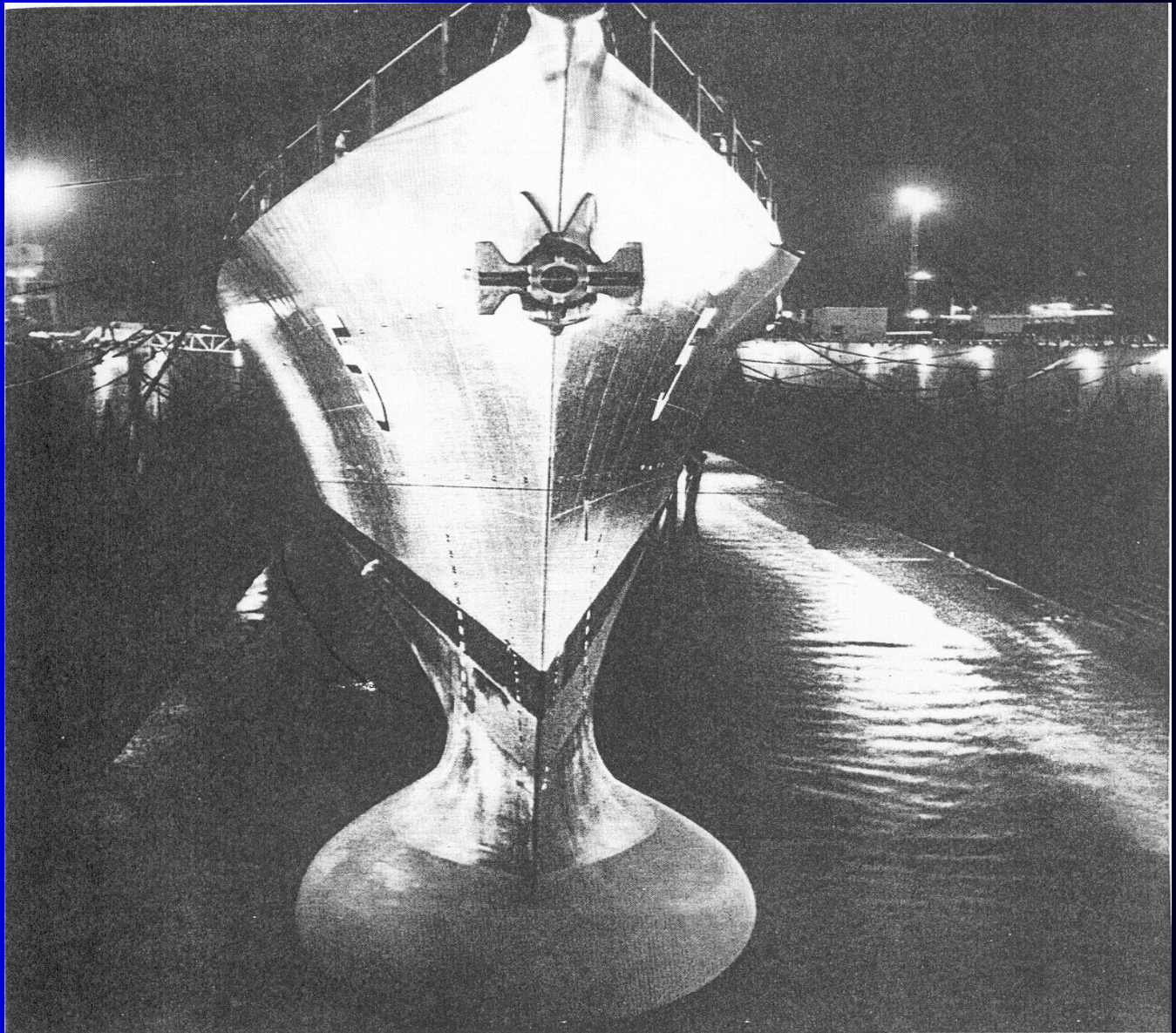
Some acoustical transducers



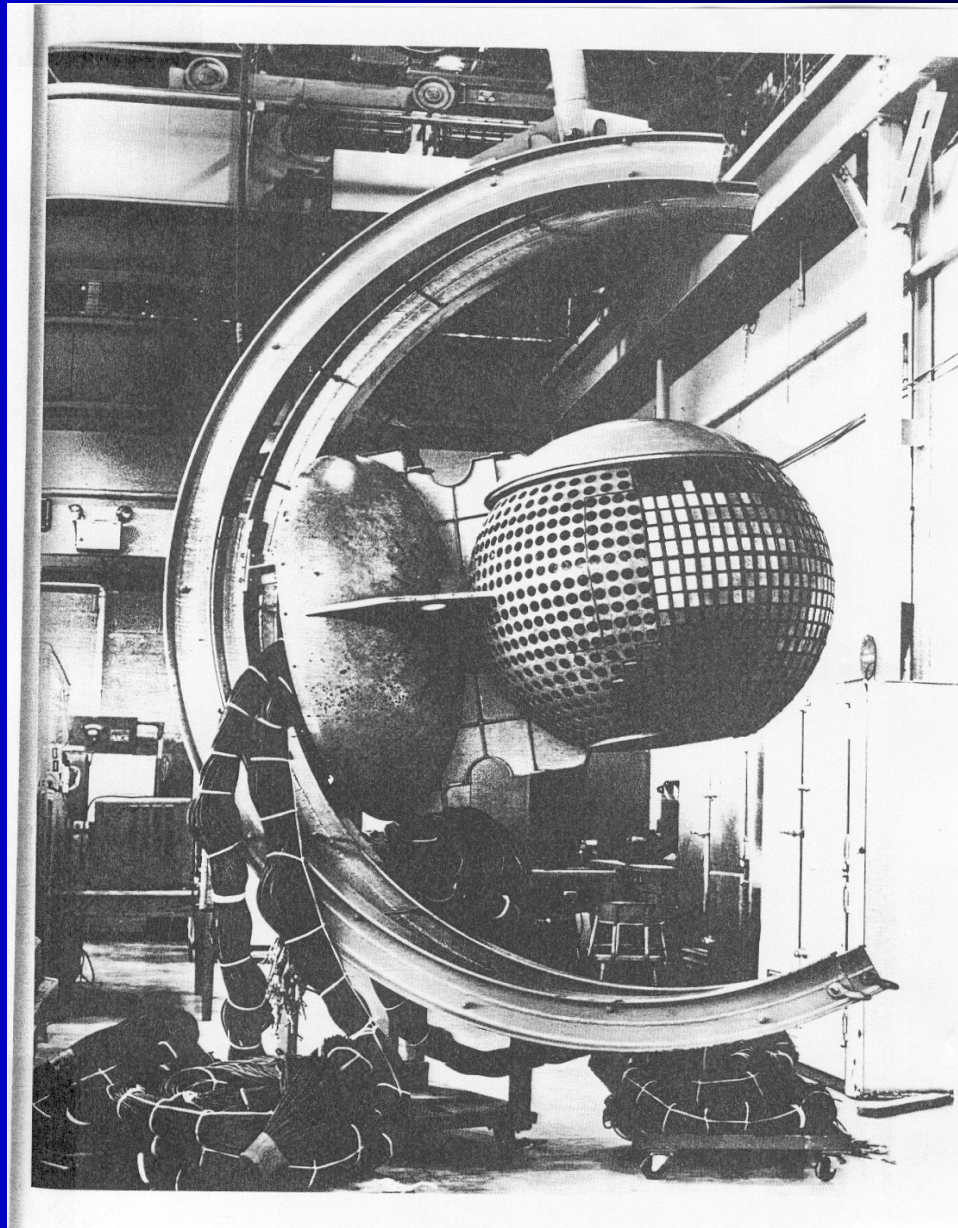
Typical Tonpilz transducer



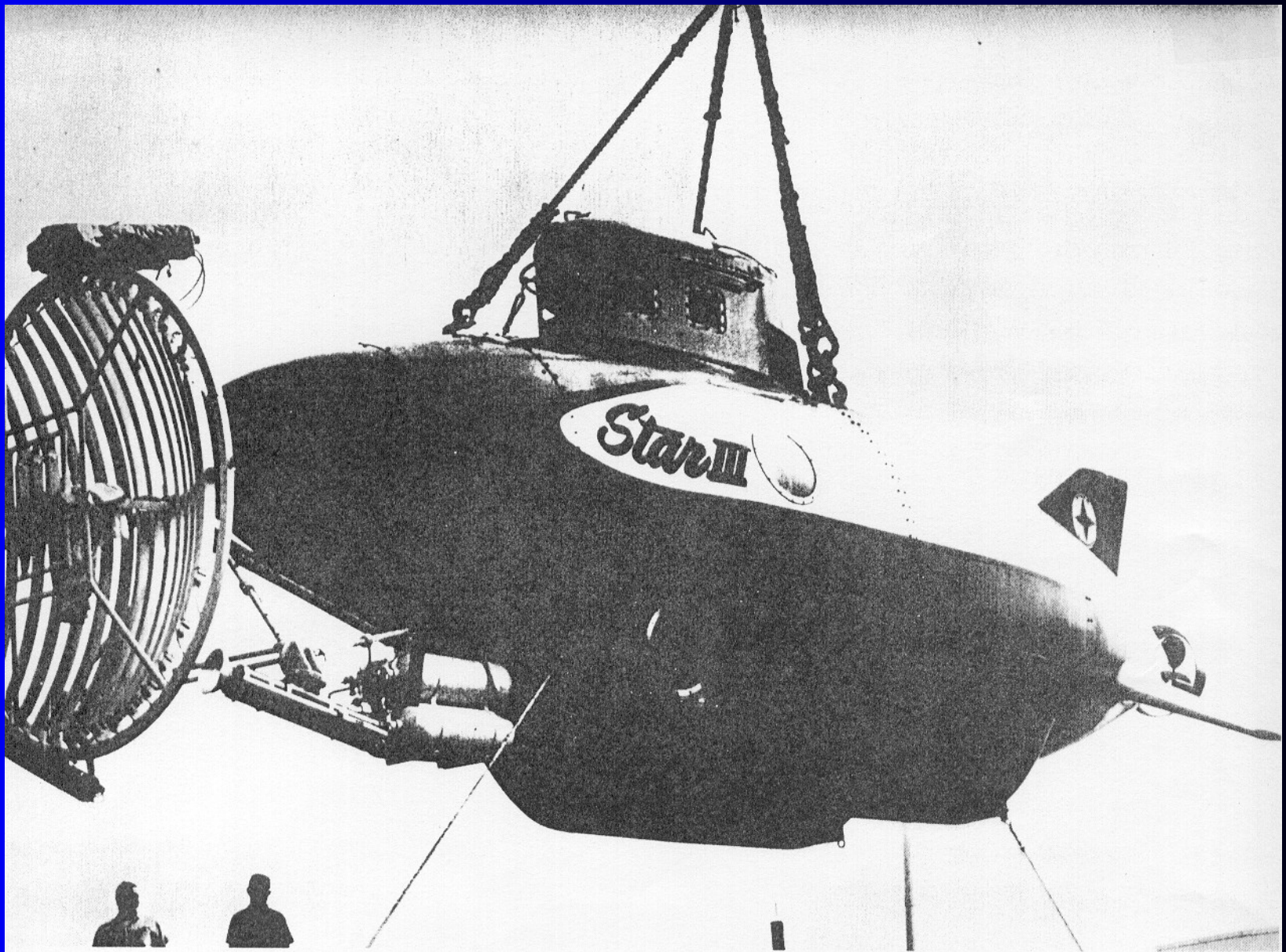
Array for Artemis project



Sonar dome and array on a surface ship

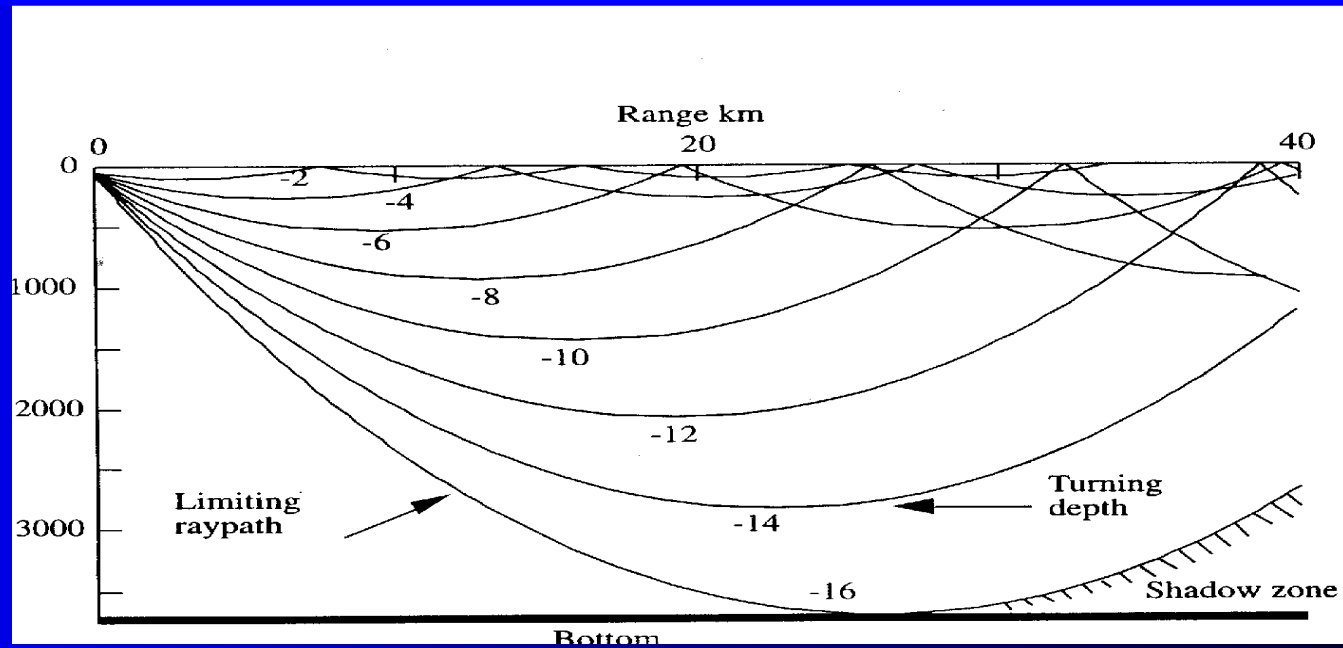


Spherical sonar array for SSN's

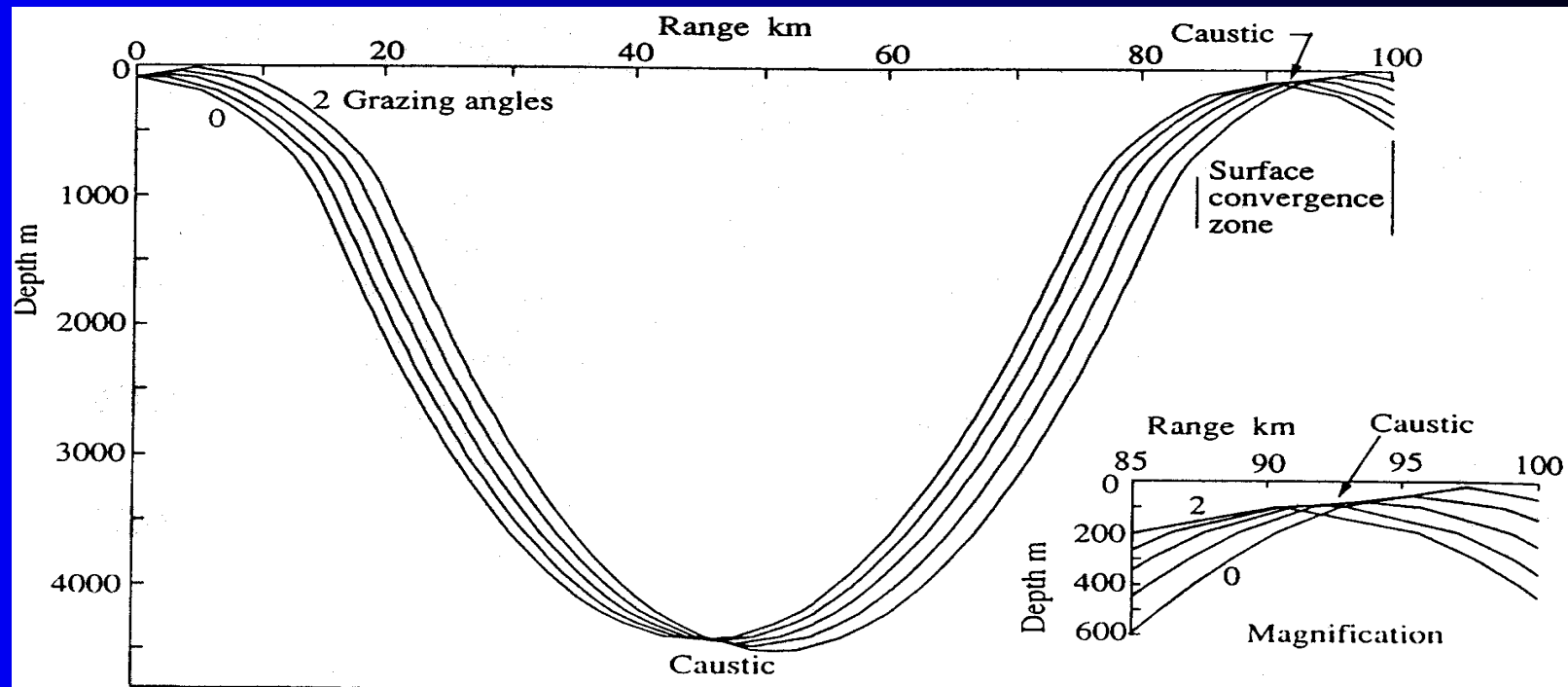


Parabolic sonar antenna on an underwater research vehicle

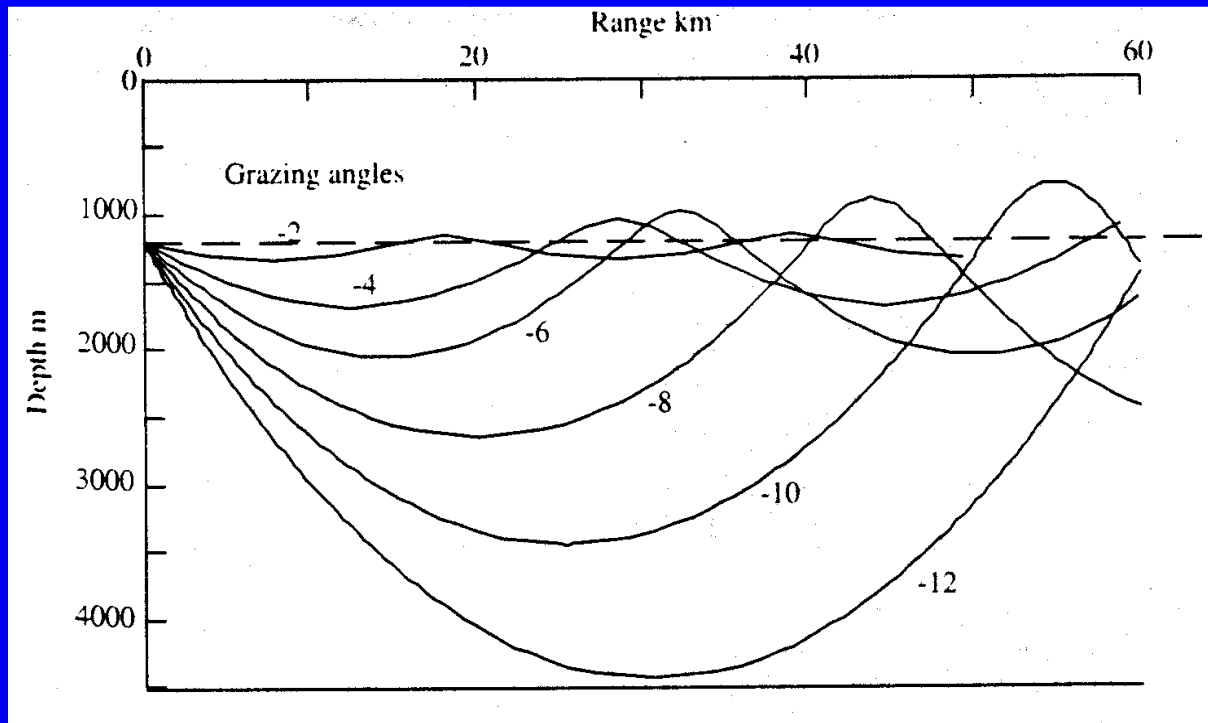
Acoustic propagation in the Ocean



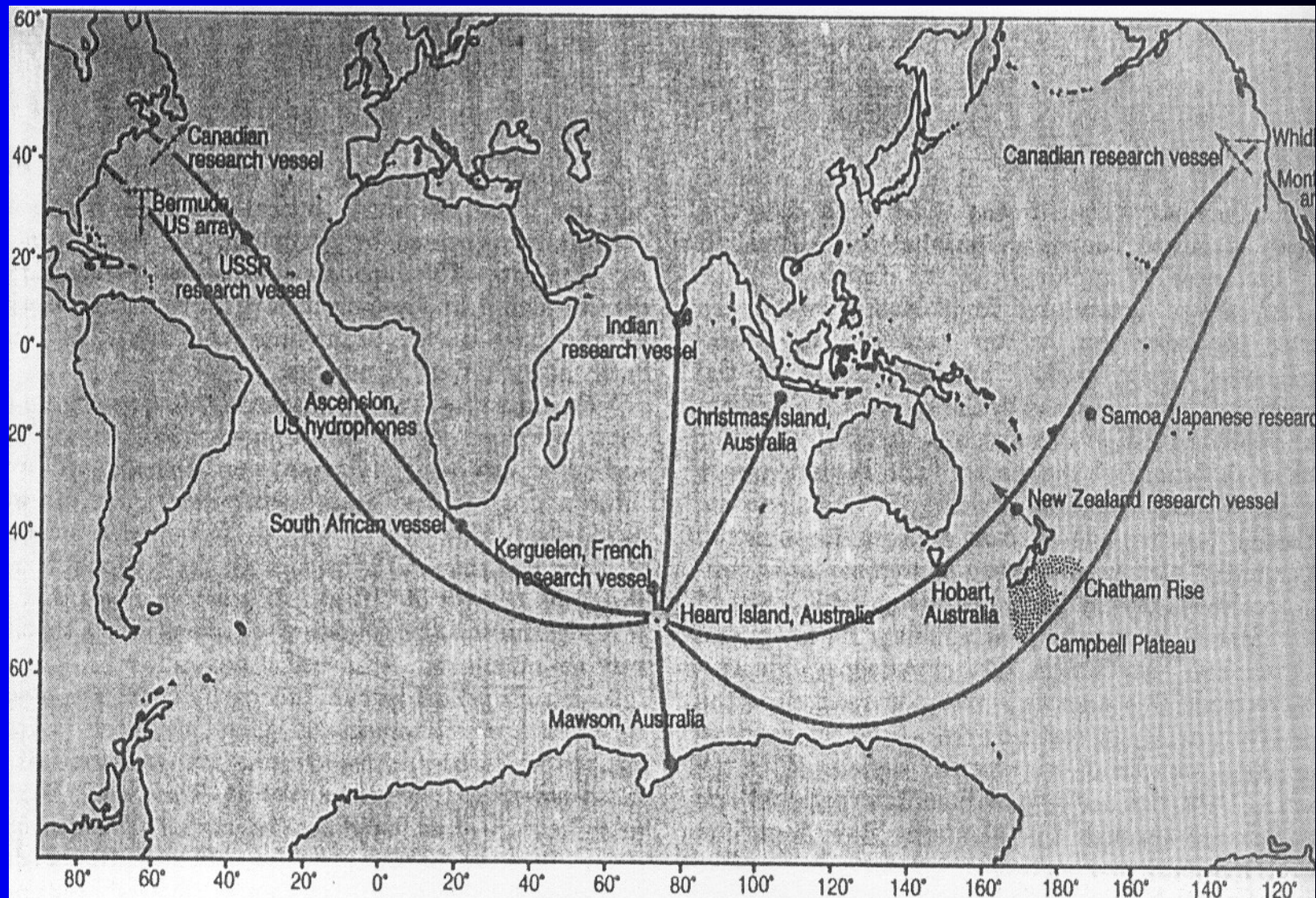
Surface duct propagation



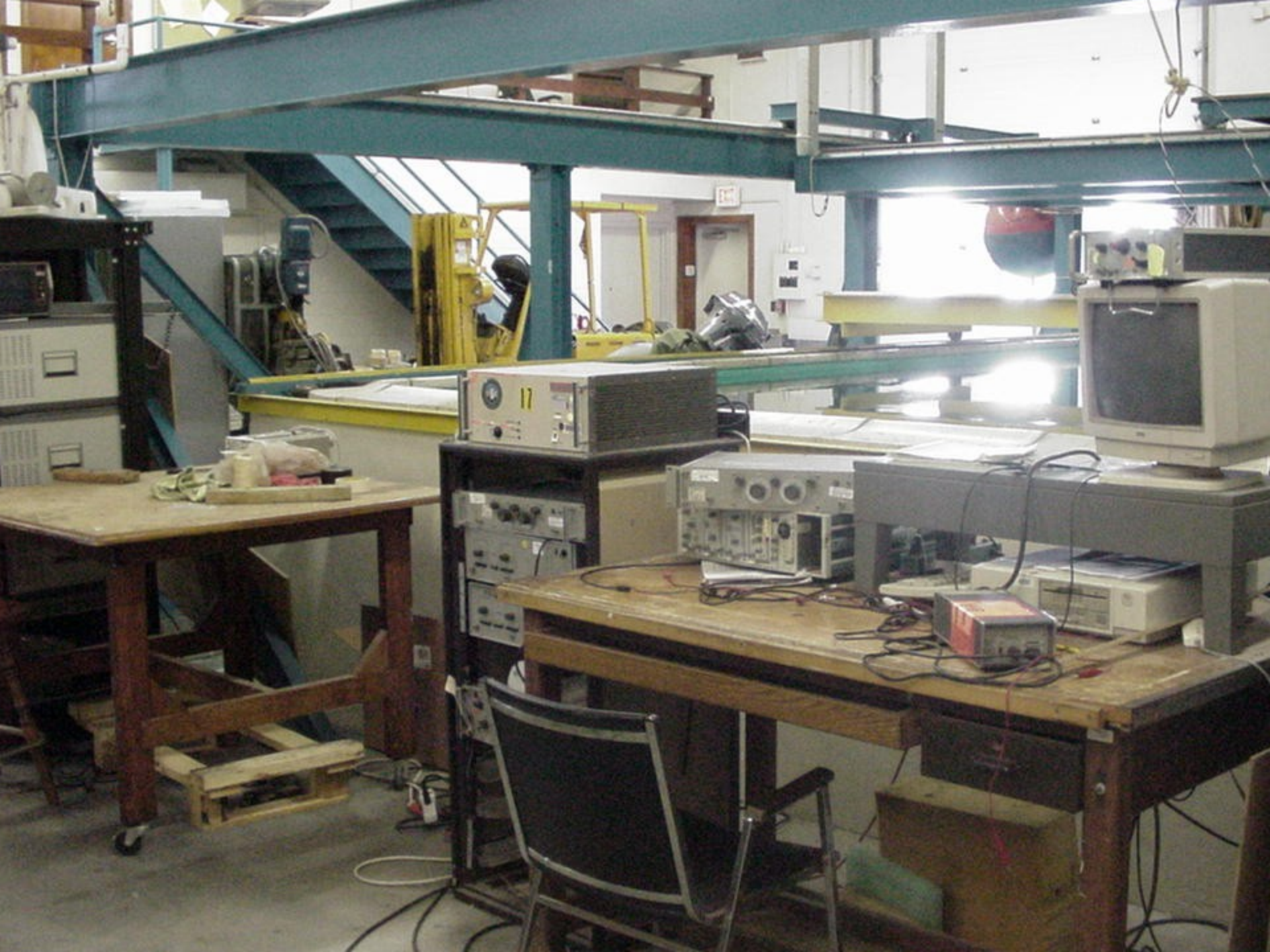
Acoustic convergence zone



SOFAR sound channel



The Heard Island Experiment











The ideal setting for research in underwater acoustics !!

